Chapter (4) : Control System Design

Problem Description:

Design of the truck is based on using many actuators, each of these is specialized in doing a specific operation, For example the project has a prime mover which is responsible for supplying hole project with energy, and four hydraulic cylinders and a hydraulic motor, finally the project contains an unloading valve to save lost power, each one is actuated by a Directional Control valve, This type of valves is operated by receiving an electrical signal from control unit.

Pre-analysis:

The project totally has six valves, five of them has double solenoid coil, and the sixth one has single coil, as known that the coil need a signal from the operator which is sent through the control unit, also the electric motor needs a signal too.

Now, the signals we have are as the following:

Inputs:

- Two signals for operating lift cylinder.
- Two signals for operating carriage cylinder.
- Two signals for operating tilt cylinder.
- Two signals for operating steering cylinder.
- Two signals for operating hydraulic motor.
- Two signals for operating electrical motor.

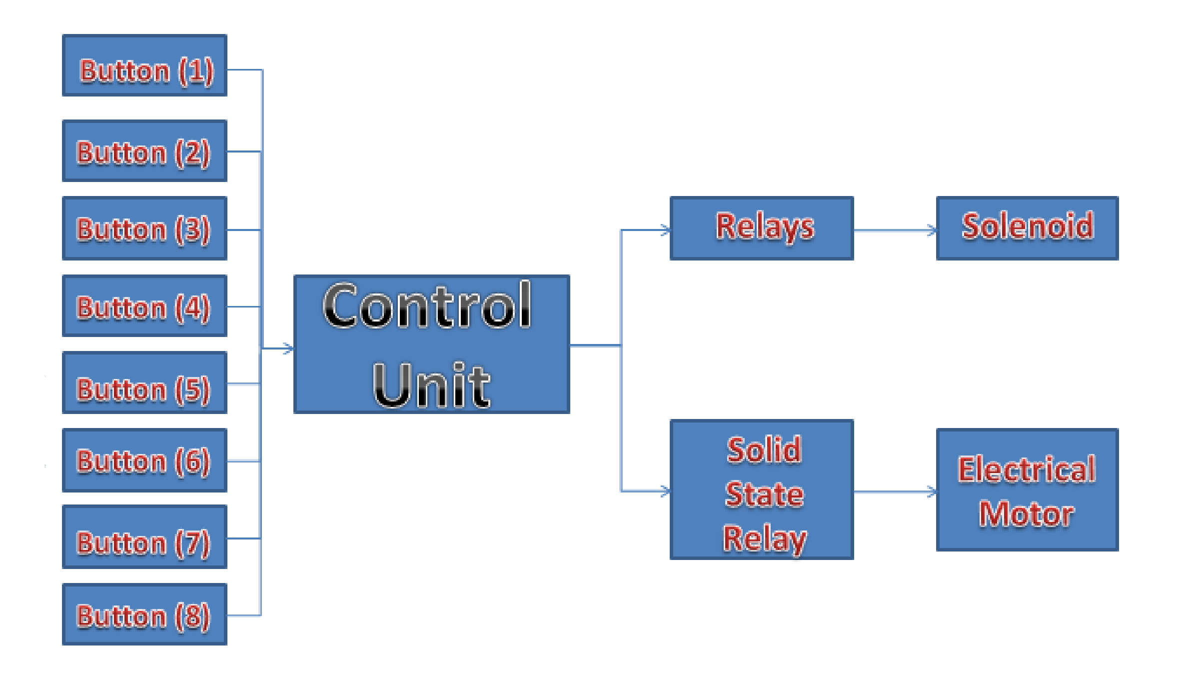
Design

- High level design
- Intermediate level

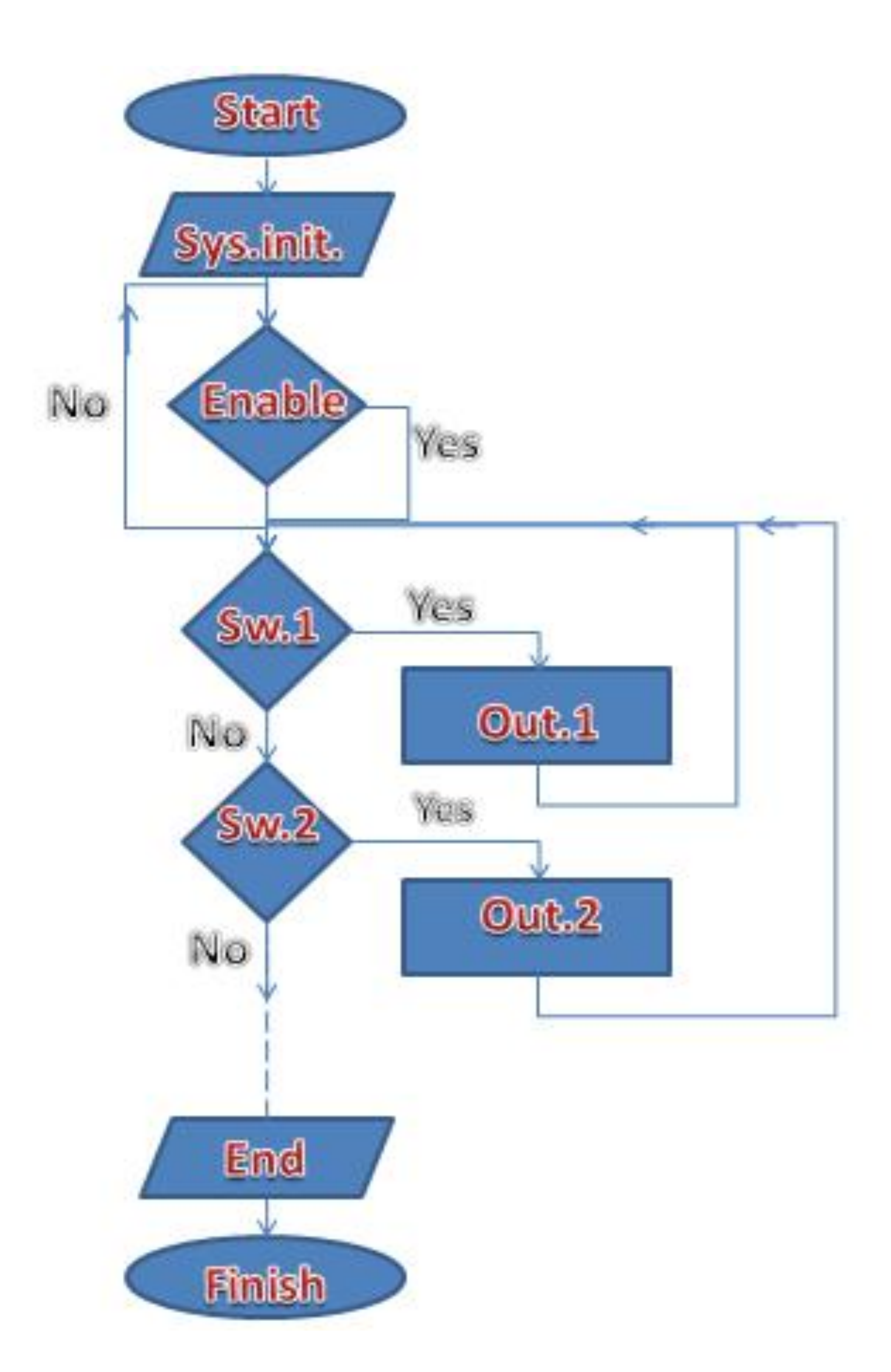
High level design



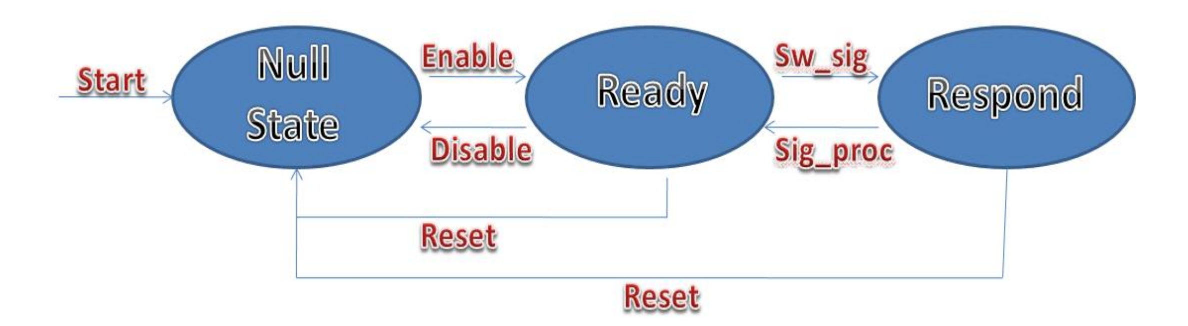
Intermediate level design



Flow chart control system:

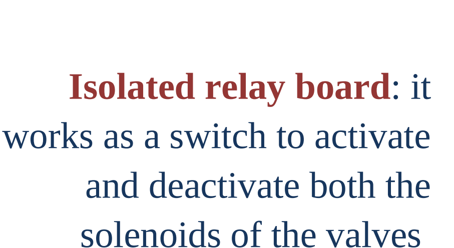


State machine diagram

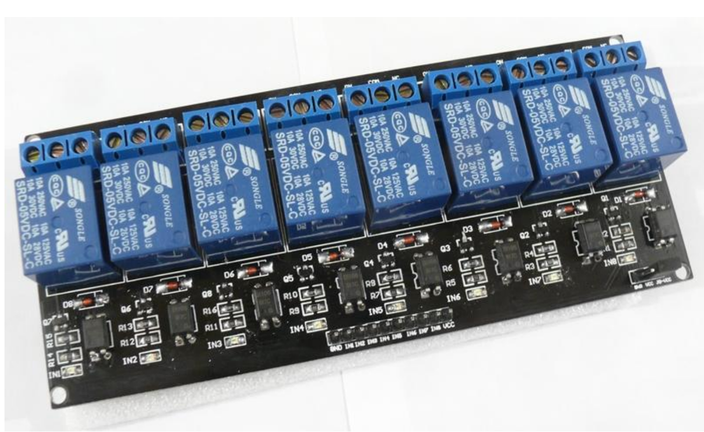


Electric components:

- **power supply** 220 volt to 24 (5 amp) to supply the solenoid of the valves with the required electricity to actuate the valve



Isolated relay board: it works as a switch to activate and deactivate both the solenoids of the valves





Solid state relay :
It works as a switch to activate and deactivate the prime-mover

Remote control object (Joystick) : it's the element which the user handles and gives orders through it, it's responsible for sending signals to the Control Unit.

It has some buttons that programmed to be ready for giving orders to the actuators.

